

1. A method of determining range of a radar target comprising:
receiving signal samples based on returns of a target during tracking;
processing the signal samples to produce a wideband envelope range estimate for
components of target motion comprising precession and spin motion components;
5 measuring the signal samples to produce ambiguous phase values; and
using each wideband envelope range estimate and ambiguous phase value to produce an
unambiguous phase value indicative of range.
2. The method of claim 1, further comprising:
10 determining an estimate of ballistic trajectory for the signal samples; and
removing the estimated ballistic trajectory during processing.
3. The method of claim 1 wherein processing operates at a sampling rate that is at least
twice the frequency of the spin motion components.
- 15 4. The method of claim 2 wherein using comprises:
subtracting the measured ambiguous phase from the wideband envelope range estimate
to produce an error value associated with the wideband envelope range estimate; and
subtracting the error value from the wideband envelope range estimate to give the
20 unambiguous phase value.
5. The method of claim 4 further comprising:
determining a magnitude of the error value and
adjusting resources of a radar system that performs the tracking to ensure that the
25 magnitude of the error is less than a one sigma error.
6. The method of claim 5 wherein the radar system resources comprise signal-to-noise ratio.
7. The method of claim 6 wherein the radar system resources further comprise data rate.
- 30 6. The method of claim 4 wherein processing comprises:
producing a spectrum of wideband envelope range estimates from the signal samples;

transforming the wideband envelope range estimates to obtain a spectral estimate of each motion component of precession, spin, spin plus precession and spin minus precession;

detecting each motion component;

estimating amplitude, frequency and phase for each motion component spectral estimate;

5 and

forming a sinusoid in range motion from the estimate of amplitude, frequency and phase for each motion component spectral estimate.

7. The method of claim 6 wherein processing occurs in batch mode for signal samples
10 obtained during several cycles of precession motion.

8. The method of claim 6 wherein the signal samples comprise pulses and using further comprises:
using the sinusoid in range motion to determine an integer number k of cycles in phase
15 change between the pulses.

9. The method of claim 8 wherein using further comprising adding $2\pi k$ to the measured ambiguous phase value prior to subtracting the measured ambiguous phase value from the wideband envelope range estimate.
20

10. An apparatus for determining range of a radar target comprising:
a stored computer program in memory instituting the steps of
processing the signal samples based on returns of a target during tracking to produce a wideband envelope range estimate for components of target motion comprising precession and
25 spin motion components;
measuring the signal samples to produce ambiguous phase values; and
using each wideband envelope range estimate and ambiguous phase value to produce an unambiguous phase value indicative of range.

30 11. An apparatus for determining range of a radar target comprising comprising:

means for processing the signal samples based on returns of a target during tracking to produce a wideband envelope range estimate for components of target motion comprising precession and spin motion components;

means for measuring the signal samples to produce ambiguous phase values; and

5 means for using each wideband envelope range estimate and ambiguous phase value to produce an unambiguous phase value indicative of range.

12. A system comprising:

a transmitter/receiver to direct transmit signals to and receive return signals from a target;

10 a processor to process the return signals as in-phase and quadrature samples to produce angle information and range signals;

a tracker to track a target detected according to results of the processing by the first processor, the tracker measuring range data during tracking and estimating a ballistic trajectory therefrom; and

15 a unit operable to use a wideband envelope range estimate of the in-phase and quadrature samples, the ballistic trajectory estimate and an ambiguous phase measurement of the in-phase and quadrature samples to produce a range measurement that is unambiguous in phase.